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FEDERAL AVIATION AGENCY

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CONTENTS PAGE

List of Illustrations

A USAF pilot has been assigned to this Detachment. He flys on some of the NAFEC tasks and renders flight observations which are included in these reports.

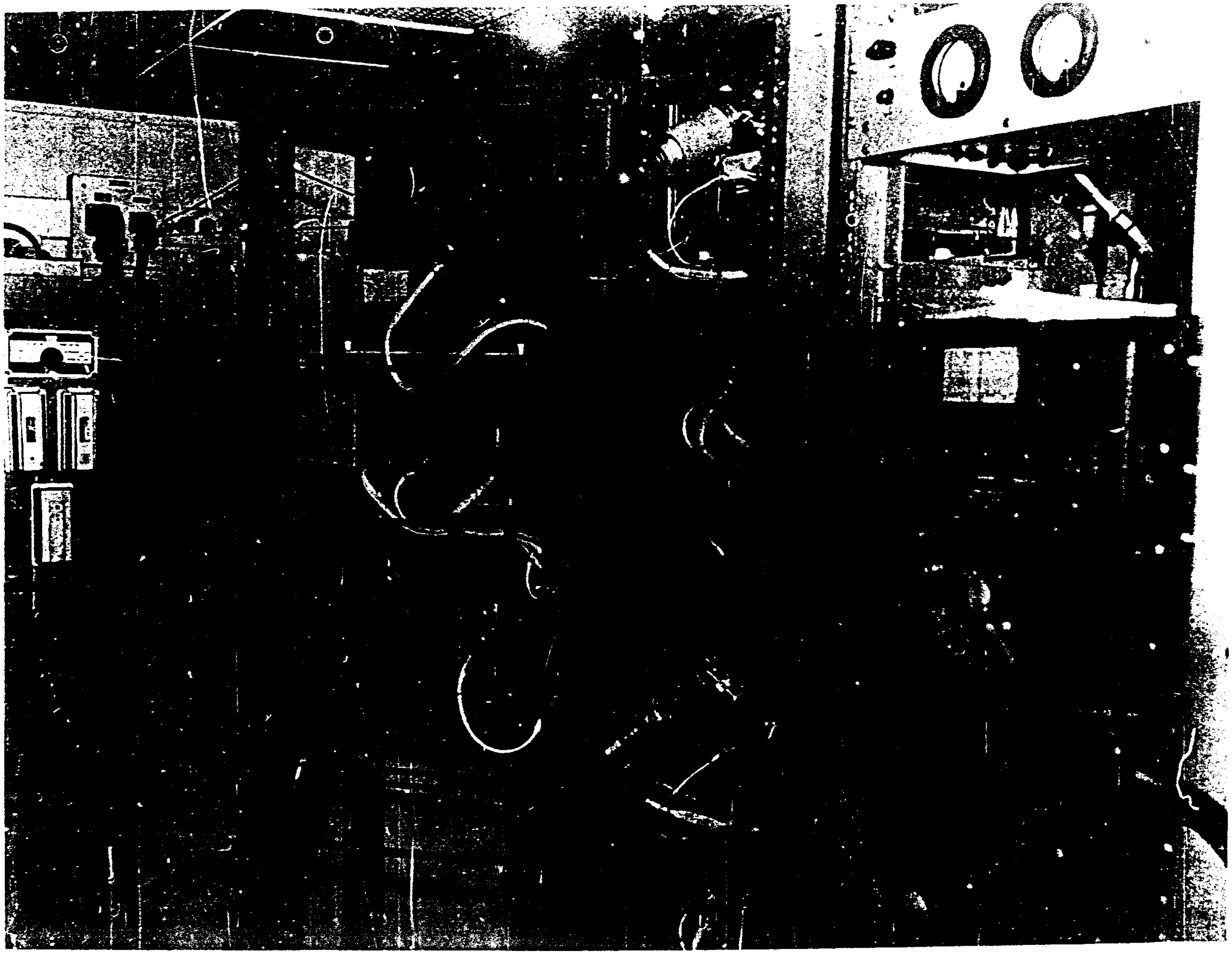

FIG. 1   AN GSN-5A INTERIOR OF EQUIPMENT VAN

APPROACH AND LANDING SYSTEMS

AN/GSN-5A

The AN/GSN-5A equipment was air lifted from McGuire AFB to Griffiss AFB for the purpose of conducting Category II and III tests in accordance with the approved test plan. The radar trailers and operations van are installed on a temporary site adjacent to Runway 33. As soon as the frost is out of the ground, a concrete pad will be constructed near the present site.

The primary test bed for this test program will be an F-102 which is now located at the Bell Aerosystems plant in Niagara Falls, N. Y. for the installation of automatic throttle and de-crab components. There are a number of time compliance technical orders which must be accomplished before the aircraft is ready to fly. An installation team from MAAMA will travel to Niagara Falls to do the work on the aircraft when all the parts have been received.

BLEU Landing System

The latest estimate for arrival of the DC-7 test bed is June 1962. Some difficulties were encountered with the airborne installation during the preliminary flight tests in Great Britain. The course bending problem in the ground installation at NAFEC has apparently been solved.

REGAL

Flight testing of the REGAL System is still suspended. Data reduction is continuing. An interim report is being prepared in which vertical control and guidance will be analyzed.

EGAL (AIL) Landing System

EGAL equipment has been delivered and is being installed. The test program is divided into two parts. The first phase will evaluate the elevation accuracy of the system and is expected to take approximately two weeks. Phase two will evaluate the "Flarescan" capability which is designed to gradually decrease the rate of descent to an acceptable value, immediately before touchdown.

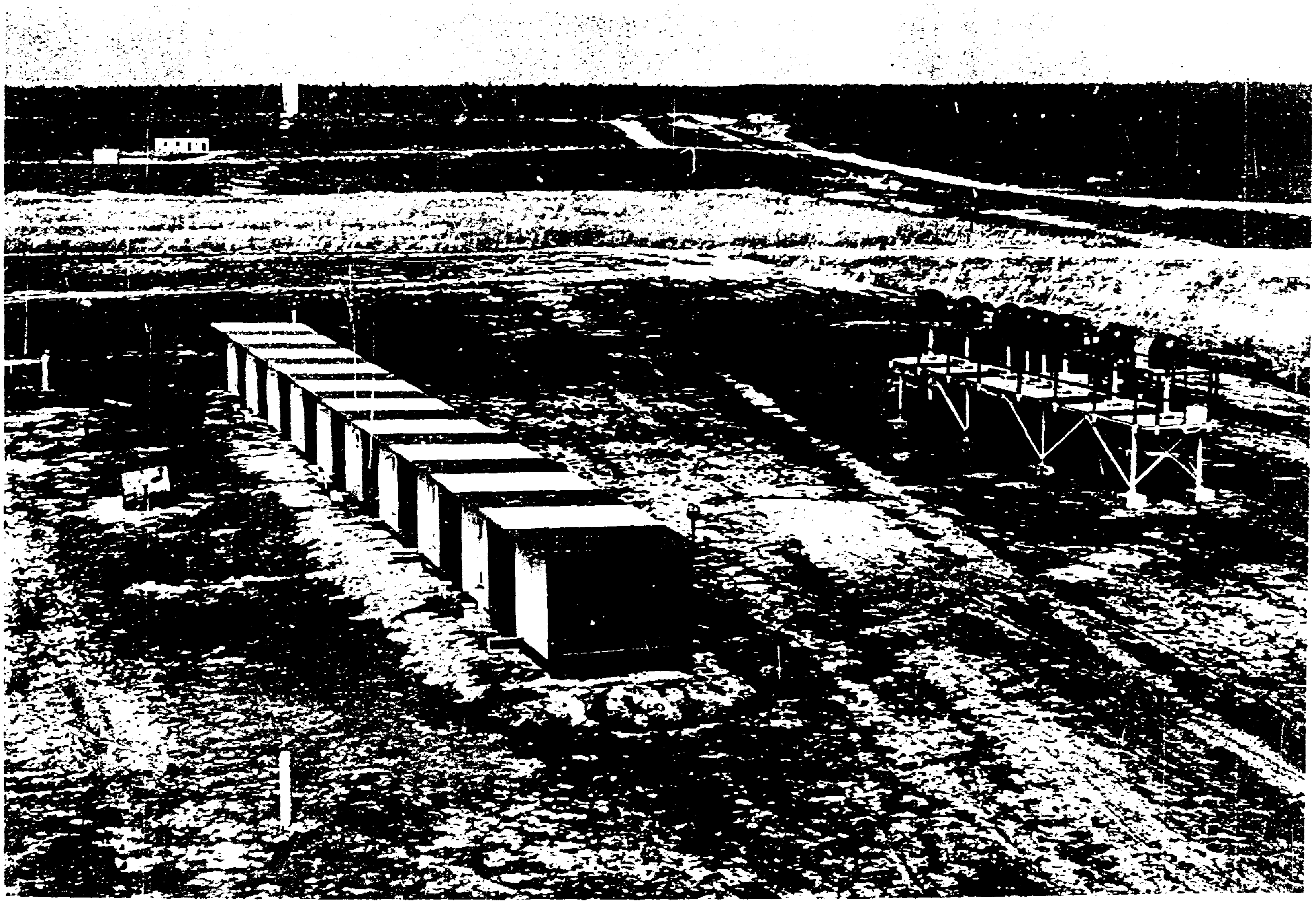

FIG 2 DIRECTIONAL LOCALIZER

Taxiing and Routing of Aircraft Coordination Equipment (TRACE)

1. Induction Loop Method. Ten of the new General Railway Signal (GRS) detectors will be installed at NAFEC. Some will be connected to existing detector loops, while others are to be fastened to new loops. Low loss leads will be used to connect some of the new units to the far detector loops.

2. Radar Detection Method. The task manager has been invited to inspect the breadboard model of the new radar unit, at AIL on 1 April 1962. The delivery date of the new unit has been changed from April to June 1962.

AN/APN-114

The TF-102 has arrived at NAFEC and the installation of vertical accelerometers and a timing receiver is progressing. Flight tests are expected to be delayed from two to three weeks because the FAA-Autonetics contract for engineering services has not been signed.

Flush-Mounted Glide Slope Antenna

A five-element flush-mounted glide-path array has been installed at NAFEC. This system is designed to produce a straight-line path whose vertical limits converge from a thickness of some 400 feet at the outer marker, to approximately 20 feet near the threshold of the runway and then remain essentially parallel. This glide path is compatible, in all respects, with present airborne equipment, and only minor transmission line modification need be made in the ground-based transmitter.

This glide-path system, while using the conventional glide-path transmitter and airborne receiving equipment, employs a new type antenna in a longitudinal array. This is a traveling wave type antenna designed to emit low-angle radiation, and is of rugged construction for direct runway installation. With less than one watt provided at its terminals, this antenna is capable of radiating adequate signal for a glide path. Its dimensions are 20 feet long, 14.6 inches wide and 7.6 inches deep, which includes a 0.6-inch drainage crown at the aperture to provide for rapid runoff of surface water.

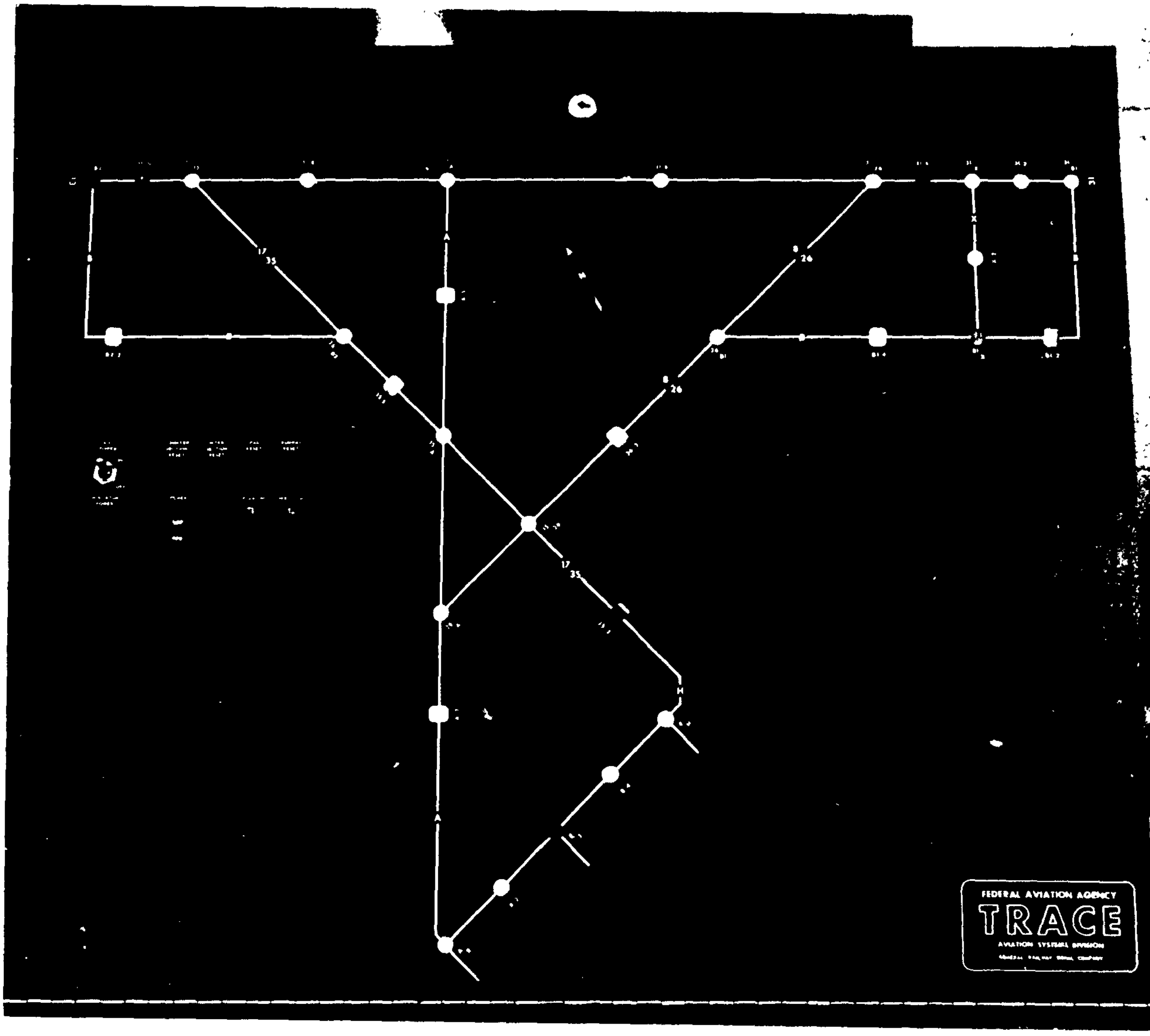

FIG 3   TRACE – TOWER DISPLAY PANEL GENERAL RAILWAY SIGNAL CO.

Five of these traveling wave antennas are used to form the glide path array. Although several precise adjustments are required, experience has shown that two or three men, with the proper equipment are able to make the necessary adjustments to align the glide path within two days. This includes tuning the antenna elements, making final spacing, amplitude, and phase adjustments. This estimate does not include laying of transmission line, antenna installation, and transmitter adjustments.

The glide path is formed by signals radiating from two antennas designated #1 and #2. A broadside modifier array provides signals when the detector is off the runway centerline in order to increase the horizontal width of the glide path. These are #3, #4, and #5. The complete array is shown in Fig. 1.

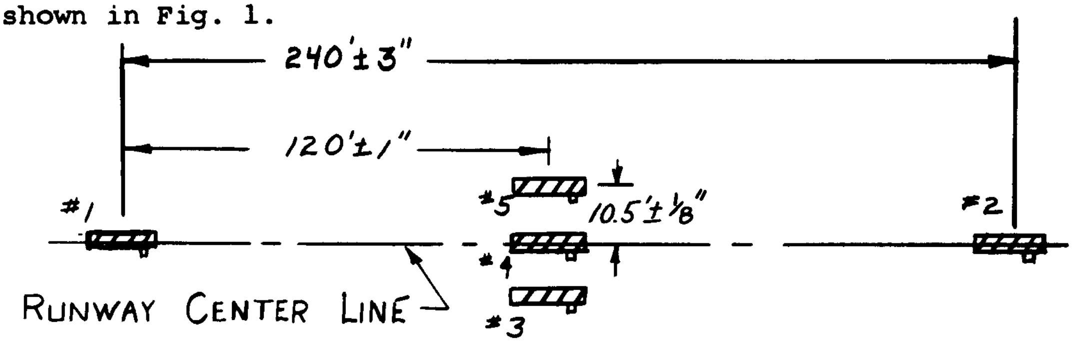

Fig. 1

The traveling wave runway antenna can be considered as a dielectric-filled waveguide with one of the narrow walls replaced by a radome. To obtain low-angle horizontally polarized radiation, it is necessary to reduce the inherently high phase velocity of the waveguide energy by the dielectric loading. The dielectric filler also serves the purpose of filling the cavity that would otherwise be present. The complete antenna weighs approximately 1200 pounds.

This glide path system was developed by the Ohio State University and initially tested by them prior to being shipped to NAFEC.

High Angle Glide Slope Antenna

There are four major objectives for this task.

1. To determine to what extent the helicopter approach capability can be improved using standard glide slope equipment (MRN-8) adjusted to 12 or 15 degrees elevation angle.

2. Determine the minimum altitude to which the facility is dependable.

3. Determine the position over the landing pad at the moment of transition to visual operation.

4. Determine the statistical spread of positional data for 95% probability. Four major variables are involved in the above determinations, thereby making four categories of data collection, each requiring fifty (50) approaches, as follows:

a. Zero wind with high vertical speed (700 ft/min.)

b. Zero wind with low vertical speed (500 ft/min.)

c. Ten to eighteen knots wind at 160° ± 20° or 340° ± 20° at high vertical speed.

d. Ten to eighteen knots wind at 160° ± 20° or 340° ± 20° at low vertical speed.

The only helicopter available for this task is an Army H-37 (BRAD-19). It is doubtful that this task will be completed as the helicopter is scheduled to return to the Army not later than 1 June 1962.

Airport Lighting

1. Red-White Visual Glide Slope Indicator. Information has been received, that by utilizing in-house funds, the existing Red-White VGSI positioned on Runway 13 will be modified to conform with the specifications produced by the Bureau of Facilities. Also, a purchase request has been submitted for an additional Red-White system to be installed on Runway 04 at this Center. The two systems will have the downwind and upwind bars spaced 700 feet apart and will use

300 W lamps and fixtures. Considering the adverse comments made by the NAFEC task manager and other lighting personnel on the performance of the 300 W Red-White system tested at Westover AFB during January 1962, as compared to the 200 W Red-White VGSI evaluated at NAFEC (January Activity Report), it is surprising that neither this office or the NAFEC task manager has any idea of what plans, if any, the Air Force has formulated to investigate this problem. The feeling exists at this Center that unless the USAF takes immediate action to improve the filters and the sensitivity of the glide slope guidance information, pilots will not be provided with the visual information that the system is capable of providing.

2. Test and Evaluation of Sylvania Simplified Approach Lights System. Considerable difficulty was experienced during the month--the electronic remote control unit continually blew fuses. Modifications to this control in the form of protective relays are being installed. As an interim measure, data collection flights were conducted using the Runway 13 approach lighting. Approaches were made using half of the Runway 13 standard approach lights, runway end identifiers and the NAFEC Red-White VGSI (not the U. S. Standard Red-White VGSI). Twelve flights were cancelled because of inclement weather.

3. Installation and Testing of 200 Watt and 100 Watt Pancake Lights. Results obtained from the 200 W Pancake Light tests indicate that the present lamp strap is unsatisfactory. After 100 hours of operation, all sixty lamps have failed. However, it is understood that a new type lamp strap may be tested in the near future.

4. Test and Evaluate Taxiway Centerline Lights. This task is falling well behind schedule. The sub contractor responsible for drilling the taxiways is progressing much slower than anticipated. To date, one tenth of the required holes have been drilled.

5. Test and Evaluate Electro-Luminescent Surface Lights. Delta Line Electric Co., the sub contractor for Sylvania Electric Products Incorporated, is still experiencing considerable difficulty in getting this lighting system to operate satisfactorily. The main problems encountered are warping of the

plexiglass light panels and recurring electrical faults. We understand that Sylvania intends to produce a round electroluminescent surface light (12" dia.). If this is true, it is doubtful whether the present fixtures will ever be completely evaluated. The Delta Line Electric Company will probably get the contract to install the twenty Westinghouse 8" electroluminescent surface lights that are to be incorporated in this evaluation.

6. Test and Evaluate Runway Crossbars and Distance-to-go Markers. The planning phase of this task is completed. The installation contract should be awarded next month.

7. Test and Evaluate Flush Mounted Lights. Future plans include installing ten flush mounted lights, manufactured by the Outlook Engineering Company, on the threshold of Runway 13. However, as these lights will be incorporated in the standard lighting system on Runway 13, it is necessary to obtain approval from Region 1, New York before installing them. NAFEC submitted this request to Region 1 but has not received a reply.

8. Experimental Enclosed Pancake Lights. Plans for this task are finalized and a Purchase Request will be forwarded to FAA Washington, during March 1962. The lights will be installed on Runway 04-22.

Evaluation of DME at ILS

The IT&T low power transponder has been installed at the end of NAFEC Runway 13. Several 20 NM orbital flights were made with the transponder set at 250 Watts output. The aircraft used a Class II interrogator.

Radar Target Handoff

The "Radar Scan Converter TV Marker Handoff" equipment, produced by Hazeltine under FAA contract and recently installed at NAFEC, is being prepared for operational feasibility. Present efforts include studies to determine time comparisons in handoffs, using this equipment versus normal handoff techniques, and to ascertain what marker-symbols are optimum on bright radar displays for positive identification of handoff targets.

The Hazeltine equipment, as well as the Marker-Handoff system into which it has been integrated is being debugged. A technical problem involving a deficiency in the coordinate translation of the display marker-symbol has been encountered. This is particularly manifest when the marker-symbol appears on two displays fed by different radars and/or different Scan Converters. Although the difficulty can be minimized to some extent by offset on one display and by using special procedure, other inherent factors, such as minor variances between two Scan Converters, apparently preclude the possibility of eliminating the problem in the present system configuration at NAFEC.

COMMUNICATIONS

Air Ground Air (Digital) Communications System

Flight tests of the new experimental compact Airborne Insertion Display Equipment (AIDE) have progressed slowly during February 1962. Ten flights have been flown since January; approximately five to ten more flights are required to complete the tests.

The new AIDE unit, which provides a message readout and a message sending capability for the pilot, appears to be performing satisfactorily. Positioning of the readout tapes are accomplished directly through digital signal impulses without conversion to analog voltages.

Some mechanical difficulties have been experienced such as the tearing of readout tapes. However, these are considered minor problems inasmuch as the unit is a breadboard configuration.

Delivery of the page printer teletype readout unit is anticipated in March 1962.

FIG. 4 DATA PROCESSING CENTRAL FLIGHT PLAN GROUP

DATA ACQUISITION AND PROCESSING

AN/GSN-11

1. Evaluation. The "Series A" portion of the FAA evaluation of the AN/GSN-11 continued throughout the month. NAFEC aircraft were scheduled for 18 days of test flights during this period. Seven and one half days were lost due to weather, two and one half days were lost due to non-availability of aircraft, one and one half days were lost due to radar outages and one and one half days were lost due to measurement equipment outages. In the remaining five days 24 Volscan approaches were made to NAFEC Runway 31. These approaches yielded 6 hours of effective utilization of the AN/GSN-11 for evaluation purposes. Not included in the above totals are four approaches provided by USAF aircraft (B-47 and F-102). These four approaches are not included as valid "Series A" runs since the MSQ-1 was unable to track the aircraft. In addition, two approaches were made to the AN/GSN-5 gate in order to check ability of the AN/GSN-11 to feed the AN/GSN-5. It appears that these two systems can be made to work together.

To date, there have been 501 approaches utilizing 99 net effective hours of flight tests for the AN/GSN-11. Arrival times at the GCA gate have averaged -0.7 seconds with a deviation of ±14.5 seconds. Lateral displacement from the runway centerline extension has been less than 1000 feet for 89 per cent of the runs.

2. Problem Areas. The following problems were encountered and remain unresolved:

a. Air Space. As noted above, seven and one half days or fifteen test periods were lost due to weather. Altitude blocks of Airway V139 could not be obtained resulting in cancellation of test runs during IFR conditions. Lack of sufficient controlled air space will seriously affect the test schedule.

Data Processing Central (DPC)

The DPC development program is, at this stage, embodied within prototype computers, consoles and associated equipments which are installed at NAFEC. It has been established that

this existing configuration will serve as a test bed to evaluate semi-automatic Air Traffic Control (ATC) concepts; however, much work remains to be accomplished integrating the numerous sundry units and achieving sufficient system reliability before the test bed status can be realized.

A myriad of difficulties have been experienced and continue to plague the engineers and programmers associated with the DPC effort. These problems, perhaps normal in a development effort of this magnitude and complexity, have resulted in continuous slipping of scheduled completion dates and milestones which were unrealistic when established. Nevertheless pressure has been mounting to take whatever measures may be required to achieve adequate system operation and reliability within the next few months.

Various courses of action are being considered such as:

1. Increasing contractor's role to include complete management as well as engineering services. In effect, this would allow complete domination of the development by the contractor and he would be required to provide a useful operating (test bed) system within a proposed six-month period.

2. Maintaining FAA management of the program and utilizing contractor services on a limited basis similar to present arrangement.

With regard to item (2) above, feeling exists among individual FAA personnel, familiar with the DPC effort, that a major problem area is the computer itself. The capability of the computer is at best marginal and may prove to be inadequate, specifically with regard to the core memory function. The opinion is held by some that other computers which are available, are superior to the present DPC computer from both functional and reliability standpoints. At least one such computer is installed at NAFEC. It is opined that integration of this computer into the DPC test bed is technically feasible and could be accomplished in six months. This computer has a 32,000 words-in-core capability versus the DPC computer's 4000 to 5000 words core memory.

A decision is pending at the FAA Air Research and Development Service in Washington as to what action will be taken to complete the necessary work on the DPC test bed configuration. Further decisions pertaining to development of an ATC system compatible with the criteria or recommendations provided by the Hough Committee under the recent Project Beacon evaluation will be made later this year.

Beacon Video Processing Equipment (BVPE)

Acceptance tests are virtually completed and debugging has been accomplished. Preparations are underway to initiate Technical and Operational Evaluation Tests in April 1962. Approximately 65 flight tests are planned. The aircraft installations will consist of Altitude Transmission Equipment--manufactured by Aircraft Instrument Laboratories--integrated with RCA type transponders to provide identification and altitude information.

The evaluation will also be supplemented with additional data obtained from simulation tests. An interim report will be issued following completion of the flight tests, probably before July 1962.

NAVIGATION

Doppler VOR

Doppler VOR Distributors. The double sideband distributors manufactured by the Collins Radio Co., Cedar Rapids, Iowa and the Hazeltine Corp., Little Neck, N. Y., are being tested.

The reports of the Doppler VOR Sideband Transmitters, VOR Channel Spacing, Ocean Station VOR/DME and VORTAC Relative Field Intensity are in various stages of completion.

Radio Doppler Direction Finding

The Commutated Antenna Direction Finding (CADF) equipment is ready for installation in the tower environment site at NAFEC. The Servo report is nearing completion.

Minimum Air Navigation System (MAN)

The summing amplifier drifts. To ascertain the cause of this malfunction the circuits are being checked and the equipment is being calibrated. A simulated VORTAC input is used to test the system, and provisions are being made to test a dual VOR.

Aircraft Collision Avoidance Programs

1. Luneberg Lens Antenna Technique. Present effort in this task involves correlating and analyzing data recently obtained during flight tests. A report is expected by April 1962.

2. Ground Bounce Technique. The flight test data has been refined and plotted by the contractor and is now available for analysis by NAFEC. However, the supporting MOPTAR data is not yet in final form. Test results will be reported sometime in May 1962.

3. Infra-Red for PWI. Flight tests will be conducted during 1962 for the purpose of investigating infra-red transmission characteristics in varied atmospheric and background environments. These tests are a first exploratory step to determine whether infra-red techniques may be applied in the development of a Proximity Warning Indicator (PWI) System.

The NAFEC test program will include approximately 12 flights over a period of two months. However, initial lead time for equipment installation in aircraft and final sorting and analysis of accumulated data will prolong the task effort to the end of 1962, at which time a final report will be prepared.

Test and Evaluate Pictorial Navigation Displays

During February the Bendix Course Line Computer was removed from the NAFEC C-131 and returned to the manufacturer for rectification. It is scheduled to be returned during April 1962. The Collins Course Line Computer was installed in the C-131 in place of the Bendix equipment and two data collection flights have been flown, revealing consistent distance error of one nautical mile. This is considered to be an inherent fault in the system and no attempt will be made to rectify it. This task, along with many other flying tasks being conducted at NAFEC is suffering from restrictions in airspace usage by having to conform to standard procedures. The test program requires an experimental route to be flown off airways at altitudes of 14,000 feet, 24,000 feet and above. Although constant radar surveillance can be provided by the NAFEC FPN-34, the FAA New York region will not give a letter of agreement allowing Pictorial Navigation Display data collection flights to be conducted off the airways in IFR conditions. During the winter months, especially, this is almost tantamount to cancellation of the majority of programmed data collection flights.

The installation of the Pictorial Computer, known as the FAA Complex in the NAFEC Gulfstream aircraft, should be finalized next month. The required wiring has been installed, but certain components have not been delivered to this Center.

Pictorial Navigation Displays for Helicopters

Six data collection flights, using the H37A helicopter, were flown this month. In all, 100 data collection flights are scheduled but the present rate of progress indicates that this task will not be completed by 1 June 1962--the scheduled date for this aircraft's return to the U. S. Army.

Test and Evaluation of Loran (A & C)

The NAFEC is conducting tests on Loran A & C to determine stability, repeatability of readings and ease of operation under laboratory conditions. Flight tests will begin in April 1962.

HELICOPTER OPERATIONS

IFR Helicopter Operations

Today, helicopters must fly IFR under existing fixed wing rules and regulations. These present rules do not permit the helicopter to take advantage of its unique operational characteristics. Landing minimums, terrain clearance, approach and departure procedures, alternate airport requirements, etc. are the same for helicopters as for fixed wing aircraft. In other words, helicopters with an IFR capability are required to fly IFR in the established fixed wing environment thereby negating, to a large extent, their operational versatility for weather flying.

The FAA has developed an Agency plan for IFR helicopter operations. Its purpose is to outline the actions required of the various services within the FAA to establish a helicopter IFR environment. The maximum use of common system navigation aids is fundamental to this effort.

The plan is based on the organizational functions and responsibilities of the participating services. The initial work will be concentrated in the New York area, and it is intended that the initial criteria and procedures apply to other areas where practicable.

A completion date of January 1963 has been established for the majority of this task however, the Agency hopes that a concentration of work in this field will permit implementation of improvements as rapidly and efficiently as possible.

The participating Services will designate representatives to ascertain their particular responsibilities and to assist in the accomplishment of the plan's objectives.

These Services are:

1. Airports Service
2. Air Traffic Service
3. Aviation Facilities Service
4. Aviation Research and Development Service
5. Flight Standards Service

Anticipated Agency action items necessary to achieve helicopter IFR capability are as follows:

1. A legal definition of helicopter instrument flight rules and the conditions and limitations under which they will be applied.
Responsible: Flight Standards Service and Air Traffic Service.

2. A regulatory description of cockpit instruments and aircraft equipments required for helicopter instrument flight rule operations.
Responsible: Flight Standards Service.

3. A thorough flight survey and data collection program to determine the VORTAC, VOR, TACAN, Radar, and L/MF coverage at low altitudes from existing facilities in the New York area.
Responsible: Flight Standards Service, Aviation Research and Development Service, Aviation Facilities Service, and Air Traffic Service.

4. Determination of airspace available for helicopter IFR operations based on item 3 (above) and minimum interference with fixed-wing aircraft operations.
Responsible: Air Traffic Service and Flight Standards Service.

5. Determination of number and type of navigation aids and siting criteria required to support helicopter IFR operations.
Responsible: Aviation Facilities Service, Flight Standards Service, Air Traffic Service, Airports Service, and Aviation Research and Development Service.

6. Selection of locations where helicopter IFR operations are to be authorized.
Responsible: Flight Standards Service, Air Traffic Service, and Airports Service.

7. Development of optimum approach and departure procedures
Responsible: Air Traffic Service and Flight Standards Service.

8. Establishment of weather minimums.
Responsible: Flight Standards Service and Air Traffice Service.

9. Establishment of route structures and associated altitude minimums based on item 3 (above).
Responsible: Air Traffic Service and Flight Standards Service.

10. Establishment of ATC procedures for the control of helicopter IFR operations.
Responsible: Air Traffic Service

11. Determination of weather services required to support helicopter IFR operations.
Responsible: Flight Standards Service, Air Traffic Service, and Aviation Research and Development Service.

12. Promulgation of regulatory action, including airspace action, as required to inaugurate helicopter operations.
Responsible: Air Traffic Service and Flight Standards Service.

13. Determination of navigation aid accuracies required for helicopter IFR operations.
Responsible: Flight Standards Service, Air Traffic Service, Aviation Facilities Service, and Aviation Research and Development Service.

14. Selection and installation of additional navigation aids as required for coverage.
Responsible: Aviation Facilities Service, Air Traffic Service, and Aviation Research and Development Service.

15. Application of criteria established in above actions to helicopter operations in specific airspace areas.
Responsible: Flight Standards Service, Air Traffic Service, Aviation Facilities Service, and Airports Service.

16. Conduct operational environment tests, including ATC service, of helicopter IFR operations in designated airspace areas.
Responsible: Flight Standards Service, Air Traffic Service, and Aviation Research and Development Service.

17. Determination of additional ATC personnel and facilities required for helicopter IFR operations in designated areas.
Responsible: Air Traffic Service, Aviation Facilities Service, and Airports Service.

18. Preparation of a time schedule for meeting requirements.
<u>Responsible</u>: All participating Services.

19. Implementation schedule for helicopter IFR operations.
<u>Responsible</u>: All participating Services.

The following Service responsibilities will apply to this project:

1. The Airports Service shall:

a. Determine heliport and helipad requirements.

b. Determine lighting and marking requirements for IFR operations at helicopter landing areas.

c. Determine optimum locations for helicopter landing areas.

d. Monitor all phases of the project and supervise activities for which primary responsibilities are assigned in the approved plan.

2. The Air Traffic Service shall:

a. Take necessary rule making actions to designate the use and allocation of navigable airspace, including terms, conditions, and limitations on its use for helicopter IFR operations.

b. Develop and establish air traffic rules and ATC procedures necessary for the safe and efficient utilization of the airspace in helicopter IFR operations.

c. Plan, direct, and supervise the operations of the Agency's air traffic control and aeronautical communications systems and facilities as required to support helicopter IFR operations.

d. Take necessary cartographic and coordination actions required to delineate route structures for helicopter IFR operations.

e. Monitor all phases of the program and supervise activities for which primary responsibilities are assigned in the approved plan.

3. The Aviation Facilities Service shall:

a. Establish programs and standards and take necessary procurement, installation, and maintenance actions with respect to the acquisition, construction, installation, commissioning, maintenance, improvement, and operational functioning of air navigation and air traffic control facilities required for helicopter IFR operations.

b. Take full responsibility for the installation of air navigation and traffic control aids required to provide aeronautical service for helicopter IFR operations.

c. Assign radio frequencies and provide necessary ground equipment as required for helicopter IFR operations.

d. Monitor all phases of the project and supervise activities for which primary responsibilities are assigned in the approved plan.

4. The Aviation Research and Development Service shall:

a. Provide project leadership for Agency coordination purposes.

b. Monitor all phases of the project and coordinate activities as required on items for which primary responsibilities are assigned outside ARDS in the approved plan.

c. Assist the other participating Services with available ARDS resources and the services of the Helicopter Operations Program. This shall include outputs from simulation studies and from helicopter flight test capability.

d. In cooperation with Flight Standards Service develop a flight data gathering program to determine the navigation coverage at low altitudes from existing facilities in representative areas.

5. The Flight Standards Service shall:

a. Develop operational standards, rules, and regulations applicable to helicopter flight in IFR weather conditions.

b. Provide for the issuance of airman, aircraft, and air carrier operating certificates and the administration of appropriate rules and regulations.

c. Administer rules and regulations governing the maintenance of equipment and inspection of aircraft, aircraft engines, and equipment and components as required for safe operation of aircraft.

d. Determine aircraft requirements.

e. Determine avionic requirements.

f. Provide for the flight inspection and airborne in-flight evaluation of aids to air navigation and communications.

g. Conduct liaison as required with the Civil Aeronautics Board.

h. Assist in the development of criteria for standard instrument approach, departure, and en route procedures.

i. Monitor all phases of the project and supervise activities for which primary responsibilities are assigned in the approved plan.

RESEARCH DIVISION ACTIVITIES

Study of Slant Path Navigation

A preliminary draft report has been prepared by Airborne Instrument Laboratory, Long Island, N. Y. for the FAA under contract No. FAA/BRD-357.

The objective of this is to report the results of an initial study regarding the feasibility, practicability and desirability of introducing airways defined in the vertical plane to accomodate climbing and descending aircraft in the terminal areas. The purpose of "slant airways" is to promote reduced communications, increased safety and a more efficient use of airspace consistent with aircraft performance.

The contractor concluded that slant airways are desirable if certain navaid accuracy requirements are met and suitable ground controller displays are provided.

The study also recommends that research programs be initiated, including some flight testing, to further investigate aircraft performance characteristics.

The contractor analyzed two major factors to determine the desirability and feasibility of slant airways for airport terminal areas.

1. An analysis of aircraft performance in climb and descent covering optimum and non-optimum performance both aerodynamically and economically. Pilot capabilities are also discussed.

2. The significance of navaid accuracy is discussed in some detail to determine the degree to which slant airways could be introduced.

Other factors analyzed are as follows:

1. Present-day traffic control procedures.

2. The impact of slant airways on flight planning, in flight and air traffic control procedures.

3. Three-dimensional displays for ground controllers.

4. The possibility of introducing a limited number of slant airways using present VORTAC equipment to provide climb/descent corridors for military interceptors, and unrestricted descent airways for supersonic transports.

5. The aspects of automatic flight and terminal area sequencing relative to slant airways.

The following are the conclusions extracted from the contractor's draft report. It should be noted however, that this report has not been approved by the FAA and the following remarks do not at this time, reflect any conclusions, opinions or recommendations by the FAA. This office does not agree with Paras. 1, 2, 4, 8, 9, 10, 12, and 15 below.

1. Slant airways will be required for future air traffic control systems. The Supersonic Transport and future short-haul subsonic jet transports (for example, Boeing 727, BAC 111) will emphasize this requirement.

2. Semi-optimum climb and descent airways for present-day and future aircraft can be provided. For descent, one profile may suffice for each class of aircraft (for example, subsonic jets, small propeller-driven aircraft, etc.). The total number of slant airways required will be based upon the number of directions of approach required to the destination airport.

For climb-out, three profiles may be necessary for present-day jets. One profile may be sufficient for the Supersonic Transport--at least in the early stages of introduction. The total number of slant airways will depend upon the number of departure directions required.

3. The siting of such slant airways will be critical with respect to aircraft performance. It would appear that for most aircraft, profiles which allow constant speed would be preferable. Such profiles will be curved, rather than a constant angle. The latter may be difficult to fly and may have altitude limits.

4. Speed limits are undesirable in the terminal area, but if proved essential to safety, they must be flexible enough to allow aircraft to achieve the performance required for conforming to slant airways.

5. There is a lack of flight-test data with which to evaluate pilot and aircraft performance, using defined climb or descent profiles that would be required in a terminal area.

6. Segregation of traffic will result from the use of slant airways. Angle of climb or descent and cruise altitude will be the primay basis of slant airway segregation.

7. To provide optimum routes, turns will be required while climbing or descending. It will be necessary to define such turns by an accurate navaid if pilot/controller communications are to be relieved and accuracy in flying slant airways is to be achieved.

8. Slant airways can only be introduced on any large scale if accurate navigational aids are available. VORTAC, as presently used, does not meet the requirements. However, a system using pairs of DME stations (rho/rho), the altimeter, and an airborne computer, would meet most of the accuracy requirements.

9. If flight tests prove that the present pressure altimeter does not have the accuracy required, vertical scanning beam navaids might be used for altitude guidance for <u>all</u> aircraft in terminal areas--regardless of whether they are flying on slant airways or not. All aircraft within a given airspace must use a common altitude reference.

10. For universal application of slant airways, three-dimensional displays for the ground controllers will be essential. Facilities for automatic time and position prediction will also be required to permit operational flexibility and allow controllers to handle unusual or emergency situations safely, and with a minimum of communications.

11. In addition, flight planning--both airlines and traffic control--must be highly accurate with regard to wind, temperature and aircraft characteristics.

12. If all these conditions are met, the use of slant airways will provide greater safety in the terminal area, reduced communications, near-optimum aircraft operation, and more efficient use of the airspace--although it does not necessarily follow that less airspace will be required.

13. Automatic flying should be possible, using slant airways. This will ease the workload on the pilot and permit more accurate flying. Certain aspects concerning profiles and navaid characteristics will have to be considered.

14. Future use of terminal area sequencing systems could compromise, or alter the requirements for, slant airways. This aspect must be carefully watched.

15. Slant airways will not necessarily eliminate holding. The question of whether to hold or stack arriving aircraft at high or low altitudes is related to whether a landing can be guaranteed or not. If normal low holding speeds are used at any altitude, it does not appear that fuel consumption is very seriously affected by the altitude of the holding pattern.

SIMULATION

The Link Airborne Fog Simulator

This fog simulator arrived at NAFEC on 14 February 1962. Installation work on the C-54 is progressing on schedule. It is hoped to start flight testing the equipment in early March 1962.

TDC Simulator

On 12 February 1962, a task--Investigation of Terminal Area Control System Design--was started on the TDC Simulator. This is the first of a series of tasks that will be conducted for the FAA System Design Team. The actual simulation will be divided into three parts.

1. Part I. Shake-down and tests of the configuration as presented by the System Design Team incorporating minor geographical modification.

2. Part II. Further tests of System Design Team plan including major modifications in the configuration parameters.

3. Part III. Comparison of three systems, that is, the present system, system using the configuration as presented by the System Design Team, and a system incorporating major changes in system parameters as derived from Parts I and II.

The following schedule has been adopted:

Part I	12 February - 16 March 1962
Part II	19 March - 13 April 1962
Part III	15 April - 27 April 1962

It is believed that the correlation of the results of these studies will provide a firm basis for the guidance of further system planning and testing. This test program will implement many of the Project Beacon terminal recommendations such as the application of CVR--Controlled Visual Rules, positive separation in the terminal area and segregation of aircraft operations.

The Model A ATC Dynamic Simulator

An evaluation task to determine the operational feasibility of "Radar Scan Converter TV Marker Handoff" equipment utilizing the Model A ATC Simulator, started on 12 February 1962 and will run into April 1962. A description of this equipment designed by Hazeltine under FAA contract (FAA/BRD 342) is contained in our January 1962 Activity Report.

AIRCRAFT SAFETY

Arresting Hook Tests

Work on the ground installations at Georgetown, Delaware is progressing satisfactorily. The task manager believes the groundwork will be completed during March and that the test program will be started in April 1962.

NAFEC Runway Slush Tests

A documentary sound film should be available in June 1962. Original procurement of 6 films is estimated.

FAA Altimeter Static Pressure Calibration Program

A TV-2 (T-33) type aircraft has been assigned for use on this program. Preliminary flights, at speeds of up to .72 Mach, will commence in April, with the detailed flight program scheduled for July 1962.

A portion of the program will be conducted at a civil air show in Reading, Pa. during June 1962. Low altitude position error, using a refined version of the NASA photographic technique, will be checked on approximately 100 airplanes. Aircraft participating will be of the general aviation executive type, that is Lockheed Vega, C-45, and Bonanza.

NAFEC Runway Braking Coefficient Tests

Tests were conducted during February 1962 at NAFEC to determine the effects of the automotive suspension system on current techniques as used by the USAF, for determining runway friction coefficients. A letter report will be released by April 1962. Preliminary findings indicate that operating techniques may have an adverse influence on test results.

WEATHER

FAA Weather Automation Program (AMOS IV)

Work is continuing on the checkout of the NAFEC installation of the AMOS IV Automatic Meteorological Observing System. Interconnection of sensors to the main station is in progress.

SUPPORT ACTIVITIES

The following items have been received by the FAA at NAFEC from USAF sources. The majority of equipments and aircraft are used in support of FAA tasks. Some of the items are USAF surplus. Fifteen systems are on loan. The AN/GSN-5(ST) and the AN/GSN-11 systems are at NAFEC for evaluation.

ASD and ESD Systems at NAFEC (Evaluation)

1.	AN/GSN-5(ST)	1	
2.	AN/GSN-11	1	
3.	AN/FPN-34	1	(See Note #1)
4.	AN/APN-114	1	Installed in TF-102 on TDY from ASD
5.	AN/GSN-3	1	(See Note #2)

USAF Formally Loaned Systems - Support of FAA

1. AN/MPN-11D, GCA Serial No. 184.

2. AN/GRT-3, AN/GRR-7, Ground Communications Equipment - 18 Units for use in support of DPC and AN/GSN-11.

3. AN/GRC-27 Ground Communications Equipment - 2 Units for use in support of DPC and AN/GSN-11.

4. AN/TRC-32 Ground Communications Equipment - 4 Units for support of NAFEC tests.

5. AN/TRC-24 Point to Point Communications Equipment - 6 Units (See Note #3).

6. AN/CPN-18, Minor Units only for support of DPC.

7. AN/ARC-3, VHF Airborne Communications Equipment - 6 Units for support of NAFEC tests.

8. AN/ARC-27, UHF Airborne Communications Equipment - 6 Units for support of NAFEC tasks.

9. AN/UPA-35 Radar Indicator - 3 Units for support of NAFEC tasks.

10. J-57-F19W Jet Engines - 2 Units for operation of NAFEC 5-foot wind tunnel.

11. J-57 Accessory Equipment - 1 Lot for operation of J-57 Engines.

12. AN/APN-81 - 1 Unit in process of being returned to USAF.

13. Project Trail Herd - 60 Items of aircraft ground handling equipment for support of USAF aircraft loaned to NAFEC.

14. AN/MRN-7, MRN-8-Mobile ILS - 1 Unit. Originally used by FAA for dual runway evaluation at Chicago, Ill., now located at NAFEC.

15. CW-750 Fire Truck on indefinite loan to NAFEC.

Aircraft

C-131B . . . . (Ser. No. 53-7819	1	TDY from ASD for support of REGAL
C-131B . . . . (Ser. No. 53-7807A 53-7822)	2	Support. On loan
C-54G . . . . (Ser. No. 45-488)	1	Support. On loan
F-102A . . . . (Ser. No. 56-1250)	1	Support. On loan
TF-102A . . . . (Ser. No. 55-4032)	1	TDY from ASD for 6 to 12 Months for support of AN/APN-114
C-45H . . . . (Reg. No. N-458)	1	USAF Surplus
C-45H . . . . (Reg. No. N-460)	1	USAF Surplus
SA-16 . . . . (Reg. No. N-459)	1	USAF Surplus
YC-131C . . . . (Reg. No. N-454)	1	USAF Surplus

Miscellaneous USAF Materiel for Support of FAA at NAFEC

1. Wright Patterson Simulator 1
2. AN/MSQ-1 4
3. AN/MRR-4 1
4. AN/MRR-6 . . . . 1 (Partial)
5. AN/GPA-26 2
6. AN/ARA-21 . . . . 2 (Partial)
7. AN/GPA-13 1

8. AN/MPX-7A 1
9. P-3 (B-25) Simulator 1
10. MB-3 (F-100) Simulator 1
11. Rectifier 28 Volt 1
12. RT-122 3
13. TI-440 Scan Converter 2
14. Radar Track and Data Display System 1
15. Radar Evaluation Set (2900-NL057-60505 1

Notes

1. The AN/FPN-34 Radar System was installed at NAFEC in 1959. A formal loan has been in process since 1961. Indications are that USAF is transferring this system to the FAA, however, nothing official has been received by this office on this subject.

2. The AN/GSN-3 Landing Control Central was received at NAFEC in 1958 for evaluation. FAA decided that no test was required and advised USAF that they planned to use the components of the XD-1 (GSN-3) for experimentation (FAA Msg 17 December 1958). FAA is now attempting to dispose of the system through the General Services Administration. Authority for this was requested from the 431L SPO on 11 January 1962.

3. FAA is in the process of returning 4 of the AN/TRC-24 to the USAF and will reimburse the USAF for the other two sets.